

12 Sep. 09

CLAIMS

1. In a system, including a plurality of transmitters which transmit from at least one of the transmitters first and second complex sequences respectively from two spatially diverse antennas of the at least one transmitter to a mobile device, the method at the mobile device comprising:

demodulating the first and second complex sequences to produce demodulated complex first and second sequences;

detecting the demodulated first and second complex sequences to produce detected complex first and second sequences by multiplying respectively the demodulated first and second complex sequences with complex conjugates thereof;

averaging a function of the complex detected first and second sequences to produce an averaged function; and

processing the averaged function to detect a time, relative to a system time reference, of at least one peak therein resultant from the transmission of the first and second complex sequences.

2. A method in accordance with claim 1 wherein:

the mobile device comprises a RAKE receiver; and

the time of the at least one peak is used to set fingers in the RAKE receiver within the mobile device.

095023-091201
FOI 60-82005660

10^3

in accordance with claim 1
m is a cellular system having
are located which transmit the
level of the peaks is detected
s is transmitted to the system
m, in response to the power
mobile device from one trans

in accordance with claim 1
m is a cellular system having
are located which transmit the
level of the peaks is detected
s is transmitted to the system
m, in response to the power
mobile device from one trans

43

accordance with claim 1 wherein the averaging is performed on the first and second sequences to produce the averaged function; and wherein the first averaging which averages the detected complex averages thereof; the second averaging of the magnitude of the complex averages; and wherein the third averaging of the magnitude of the averaged function is performed on the averaged function;

accordance with claim 1 wherein the averaging is performed over first and second sequences to produce the averaged function; and wherein the first averaging which averages the detected complex averages thereof; the second averaging of the magnitude of the complex averages; and wherein the third averaging of the magnitude of the averaged function is performed over

accordance with claim 1 wherein the averaging is performed on the first and second sequences to produce the averaged function; and wherein the first averaging which averages the detected magnitudes of the complex averages thereof; the second averaging of the magnitude of the averaged function is performed on the averaged function; and wherein

accordance with claim 1 wherein the averaging is performed on the first and second sequences to produce the averaged function; and wherein the first averaging which averages the detected complex averages thereof; the second averaging of the magnitude of the complex averages; and wherein the third averaging of the magnitude of the averaged function is performed on the averaged function;

5. A method in accordance with claim 2 wherein the averaging a function of the detected complex first and second sequences to produce the averaged function comprises:

performing a first averaging which averages the detected complex first and second sequences to produce complex averages thereof;

detecting a magnitude of the complex averages;

performing a second averaging of the magnitude of the complex averages to produce a real average; and wherein

the processing of the averaged function is performed on the real average.

6. A method in accordance with claim 3 wherein the averaging a function of the detected complex first and second sequences to produce the averaged function comprises:

performing a first averaging which averages the detected complex first and second sequences to produce complex averages thereof;

detecting a magnitude of the complex averages;

performing a second averaging of the magnitude of the complex averages to produce a real average; and wherein

the processing of the averaged function is performed on the real average.

7. A method in accordance with claim 2 wherein:

the RAKE receiver has n fingers with the number of fingers being set equal to the number of peaks m for $m \leq n$ and equal to n where $m > n$.

8. A method in accordance with claim 2 wherein:

the system is a cellular system having a plurality of base stations at which transmitters are located which transmit the first and second complex sequences, a power level of the peaks is detected by the mobile device and the power level of the peaks is transmitted to the system; and

the system, in response to the power level, controls handoff of transmissions to the mobile device from one transmitter to another transmitter in the system.

9. A method in accordance with claim 5 wherein:

the RAKE receiver has n fingers with the number of fingers being set equal to the number of peaks m for $m \leq n$ and equal to n where $m > n$.

10. A method in accordance with claim 1 wherein:

the averaged function is threshold detected to pass only peaks therein which exceed a set threshold to the processing of the averaged function.

0950001091001 E2005660

11. A method in accordance with claim 2 wherein:

the averaged function is threshold detected to pass only peaks therein
which exceed a set threshold to the processing of the averaged function.

12. A method in accordance with claim 3 wherein:

the averaged function is threshold detected to pass only peaks therein
which exceed a set threshold to the processing of the averaged function.

13. A method in accordance with claim 4 wherein:

the averaged function is threshold detected to pass only peaks therein
which exceed a set threshold to the processing of the averaged function.

14. A method in accordance with claim 5 wherein:

the averaged function is threshold detected to pass only peaks therein
which exceed a set threshold to the processing of the averaged function.

15. A method in accordance with claim 6 wherein:

the averaged function is threshold detected to pass only peaks therein
which exceed a set threshold to the processing of the averaged function.

16. A method in accordance with claim 7 wherein:

the averaged function is threshold detected to pass only peaks therein
which exceed a set threshold to the processing of the averaged function.

SECRET

which exceed a set threshold to the processing of the averaged function.

18. A method in accordance with claim 9 wherein:
the averaged function is threshold detected to pass only peaks therein
which exceed a set threshold to the processing of the averaged function.

which exceed a set threshold to the processing of the averaged function.

the set threshold level is a function of a power level in the demodulated first and second sequences.

first and second sequences.

the set threshold level is a function of a power level in the demodulated first and second sequences.

first and second sequences.

the set threshold level is set as a function of a power level in the demodulated first and second sequences.

the set threshold level is set as a function of a power level in the demodulated first and second sequences.

22. A method in accordance with claim 13 wherein:

the set threshold level is set as a function of a power level in the demodulated first and second sequences.

23. A method in accordance with claim 14 wherein:

the set threshold level is a function of a power level in the demodulated first and second sequences.

24. A method in accordance with claim 15 wherein:

the set threshold level is a function of a power level in the demodulated first and second sequences.

25. A method in accordance with claim 16 wherein:

the set threshold level is a function of a power level in the demodulated first and second sequences.

26. A method in accordance with claim 17 wherein:

the set threshold level is a function of a power level in the demodulated first and second sequences.

27. A method in accordance with claim 18 wherein:

the set threshold level is a function of a power level in the demodulated first and second sequences.

28. A method in accordance with claim 1 wherein:

the first and second sequences are transmitted as a spread spectrum transmission using a pseudonoise spreading code to spread the first and second complex sequences across a base band with each bit in the first and second sequences being spread into n chips; and

the mobile device includes a matched filter, responsive to the demodulated first and second complex sequences, comprising n stages which combine signals from at least some of the n stages to produce a matched filter output signal which is the demodulated complex first and second sequences.

29. A method in accordance with claim 28 wherein:

the number of stages n is varied under control of a processor which processes the average function.

30. A method in accordance with claim 1 wherein:

the first and second complex sequences are phase references representative of a phase of the transmitter transmitting the first and second complex sequences; and

the mobile device detects the first and second phase references and detects data transmissions to the mobile device from the one transmitter using the first and second phase references.

31. A method in accordance with claim 30 wherein:

data is transmitted simultaneously with the phase references to the mobile device and stored; and

thereafter the stored data is demodulated using the stored phase references while demodulation is turned off.

32. A method in accordance with claim 1 wherein:

the mobile device includes a matched filter, responsive to the demodulated first and second complex sequences, comprising n stages which combine signals from at least some of the n stages to produce a matched filter output signal which is the demodulated complex first and second sequences;

the first and second complex sequences are phase references representative of a phase of the transmitter transmitting the first and second complex sequences;

a data transmission is transmitted simultaneously with the phase references to the mobile device;

the mobile device includes a storage which stores the data; and

the data is retrieved from storage and is detected using the matched filter and the stored phase references while the mobile device demodulation is turned off.

33. A method in accordance with claim 1 wherein:

the transmitters comprise base stations in a mobile data system.

34. In a system including a plurality of transmitters which transmit from at least one of the transmitters first and second complex sequences respectively from two spatially diverse antennas of the at least one transmitter, a mobile device comprising:

a demodulator which demodulates the first and second complex sequences to produce demodulated first and second complex sequences;

a detector which detects the demodulated first and second complex sequences by multiplying respectively the demodulated first and second complex sequences with complex conjugates thereof to produce detected first and second complex sequences;

at least one averaging unit, responsive to the detected first and second complex sequences, which produces an averaged function of the detected first and second complex sequences; and

a processor, responsive to the averaged function, which detects a time, relative to a system time reference, of at least one peak therein resultant from the transmission of the first and second complex sequences.

35. A mobile device in accordance with claim 34 comprising:

a RAKE receiver; and

the time of the at least one peak is used to set fingers in the RAKE receiver within the mobile device.

36. A mobile device in accordance with claim 35 wherein:

the RAKE receiver has n fingers with the number of fingers being set equal to the number of peaks m for $m \leq n$ and equal to n where $m > n$.

37. A mobile device in accordance with claim 34 wherein:

the system is a cellular system having a plurality of base stations at which the transmitters are located which transmit the first and second complex sequences, a power level of the peaks is detected by the mobile device and the power level is transmitted to the system; and

the system in response to the power level the system controls handoff of transmissions to the mobile device from one transmitter to another transmitter in the system.

38. A mobile device in accordance with claim 35 wherein:

the system is a cellular system having a plurality of base stations at which transmitters are located which transmit the first and second complex sequences, a power level of the peaks is detected by the mobile device and the power level is transmitted to the system; and

the system in response to the power level the system controls handoff of transmissions to the mobile device from one transmitter to another transmitter in the system.

095003.091 FOR 60" E200560

39. A mobile device in accordance with claim 34 wherein:

the at least one averaging unit comprises a first averaging unit, responsive to the detected first complex sequence, which produces a first complex average and a second averaging unit, responsive to the detected second complex sequence, which produces a second complex average; and

a third averaging unit, responsive to a function of the first and second complex averages, which produces the averaged function.

40. A mobile device in accordance with claim 35 wherein:

the at least one averaging unit comprises a first averaging unit, responsive to the detected first complex sequence, which produces a first complex average and a second averaging unit, responsive to the detected second complex sequence, which produces a second complex average; and

a third averaging unit, responsive to a function of the first and second complex averages, which produces the averaged function.

41. A mobile device in accordance with claim 36 wherein:

the at least one averaging unit comprises a first averaging unit, responsive to the detected first complex sequence, which produces a first complex average and a second averaging unit, responsive to the detected second complex sequence, which produces a second complex average; and

a third averaging unit, responsive to a function of the first and second complex averages, which produces the averaged function.

42. A mobile device in accordance with claim 37 wherein:

the at least one averaging unit comprises a first averaging unit, responsive to the detected first complex sequence, which produces a first complex average and a second averaging unit, responsive to the detected second complex sequence, which produces a second complex average;

a third averaging unit, responsive to a function of the first and second complex averages, which produces the averaged function.

43. A mobile device in accordance with claim 38 wherein:

the at least one averaging unit comprises a first averaging unit, responsive to the detected first complex sequence, which produces a first complex average and a second averaging unit, responsive to the detected second complex sequence, which produces a second complex average;

a third averaging unit, responsive to a function of the first and second complex averages, which produces the averaged function.

44. A mobile device in accordance with claim 39 comprising:

a first magnitude detector, responsive to the first complex average and coupled to the third averaging unit, which detects a magnitude of the first complex average which is an input to the third averaging unit; and

a second magnitude detector, responsive to the first complex average
and coupled to the third averaging unit, which detects a magnitude of the second
complex average which is an input of the third averaging unit.

45. A mobile device in accordance with claim 40 comprising:

a first magnitude detector, responsive to the first complex average and
coupled to the third averaging unit, which detects a magnitude of the first complex
average which is an input to the third averaging unit; and

a second magnitude detector, responsive to the first complex average
and coupled to the third averaging unit, which detects a magnitude of the second
complex average which is an input of the third averaging unit.

46. A mobile device in accordance with claim 41 comprising:

a first magnitude detector, responsive to the first complex average and
coupled to the third averaging unit, which detects a magnitude of the first complex
average which is an input to the third averaging unit; and

a second magnitude detector, responsive to the first complex average
and coupled to the third averaging unit, which detects a magnitude of the second
complex average which is an input of the third averaging unit.

47. A mobile device in accordance with claim 42 comprising:

a first magnitude detector, responsive to the first complex average and coupled to the third averaging unit, which detects a magnitude of the first complex average which is an input to the third averaging unit; and

a second magnitude detector, responsive to the first complex average
and coupled to the third averaging unit, which detects a magnitude of the second
complex average which is an input of the third averaging unit.

48. A mobile device in accordance with claim 43 comprising:

a first magnitude detector, responsive to the first complex average and coupled to the third averaging unit, which detects a magnitude of the first complex average which is an input to the third averaging unit; and

a second magnitude detector, responsive to the first complex average
and coupled to the third averaging unit, which detects a magnitude of the second
complex average which is an input of the third averaging unit.

49. A mobile device in accordance with claim 34 comprising:

a matched filter, responsive to the demodulated first and second
complex sequences comprising n stages which combine signals from at least some
of the n stages to produce a matched filter output signal which is the demodulated
complex first and second sequences.

095003 09401
" 2205660
FOR 2160"

50. A mobile device in accordance with claim 34 wherein:

the first and second complex sequences are phase references representative of a phase of the transmitter transmitting the first and second complex sequences; and

the mobile device detects the first and second phase references and detects data transmissions to the mobile device from the one transmitter using the first and second phase references.

51. A mobile device in accordance with claim 34 comprising:

a threshold detector, coupled between the at least one averaging unit and the processor, which passes only peaks in the averaged function to the processor which exceed a set threshold.

52. A mobile device in accordance with claim 51 comprising:

a power level detector, coupled to the complex first and second sequences, which detects a power level of the complex first and second sequences and applies a control signal to the threshold detector to set the threshold in accordance with the detected power level.

53. A mobile device in accordance with claim 35 comprising:

a threshold detector, coupled between the at least one averaging unit and the processor, which passes only peaks in the averaged function to the processor which exceed a set threshold.

THE UNIVERSITY OF CHICAGO

a threshold detector, coupled between the at least one averaging unit and the processor, which passes only peaks in the averaged function to the processor which exceed a set threshold.

a power level detector, coupled to the complex first and second sequences, which detects a power level of the complex first and second sequences and applies a control signal to the threshold detector to set the threshold in accordance with the detected power level.

the mobile device includes a matched filter, responsive to the demodulated first and second complex sequences, comprising n stages which combine signals from at least some of the n stages to produce a matched filter output signal which is the demodulated complex first and second sequences;

the first and second complex sequences are phase references
representative of a phase of the transmitter transmitting the first and second complex
sequences;

data is transmitted simultaneously with the phase references to the
mobile device;

the mobile device includes a storage which stores the data; and

the data is retrieved from storage and is detected using the matched
filter and the stored phase references while the mobile device demodulation is
turned off.

0950023-091201
T02T60" E2005650